California Air Resources Board

User Guide

California Conservation Corps
Energy Corps

California Climate Investments

October 10, 2019

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List of Acronyms and Abbreviations

Acronym	Term
CARB	California Air Resources Board
CCC	California Conservation Corps
CFL	compact fluorescent lamp
DC	direct current
g	grams
GGRF	Greenhouse Gas Reduction Fund
GHG	greenhouse gas
kW	kilowatts
kWh	kilowatt hours
lbs	pounds
LED	light-emitting diode
$MTCO_2e$	metric tons of carbon dioxide equivalent
NO_x	nitrous oxide
$PM_{2.5}$	particulate matter with a diameter less than 2.5 micrometers
PV	photovoltaic
ROG	reactive organic gas
W	watts

Section A. Introduction

For the CCC Energy Corps, California Air Resources Board CARB staff developed the Energy Corps Benefits Calculator Tool and accompanying Energy Corps Quantification Methodology to provide guidance for estimating the GHG emission reductions and selected co-benefits of each proposed project component. This User Guide provides instructions for using the Energy Corps Benefits Calculator Tool (Section B) and an example project (Section C).

The Energy Corps Benefits Calculator Tool and supporting Energy Corps Quantification Methodology are available for download at: www.arb.ca.gov/cci-resources. The Energy Corps Quantification Methodology provides methods and equations used in the Energy Corps Benefits Calculator Tool for estimating GHG emission reductions and air pollutant emission co-benefits. The Energy Corps Quantification Methodology also describes tool used to generate project-specific inputs.

Updates

CARB staff periodically review each quantification methodology and benefits calculator tool to evaluate their effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified. CARB updated the Energy Corps Quantification Methodology and Energy Corps Benefits Calculator Tool from the previous versions[1] to enhance the analysis and provide additional clarity, including the following additions:

- Equations to estimate GHG emission reductions and co-benefits from solar PV electricity generation; and
- Updated electricity price information.

Program Assistance

Project sponsors should consult the following resources for additional questions and comments:

- Questions on this document should be sent to: GGRFProgram@arb.ca.gov.
- For more information on CARB's efforts to support implementation of California Climate Investments, see: www.arb.ca.gov/auctionproceeds.
- Questions pertaining to the Energy Corps should be sent to: energycorps@ccc.ca.gov.

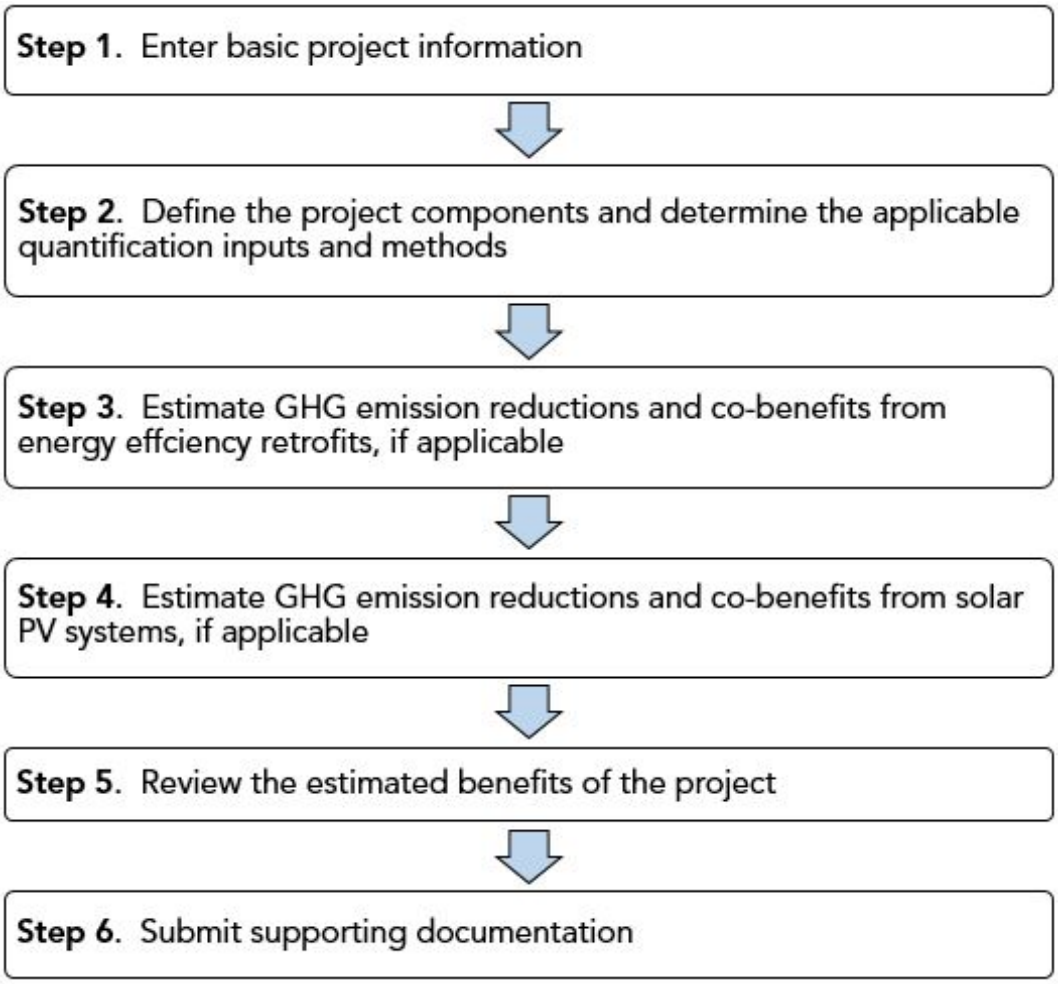
[1] California Air Resources Board. February 2019. https://ww2.arb.ca.gov/our-work/programs/california-climate-investments/cci-archived-quantification-materials

Section B. Step-by-Step Guide

Overview

A project is the combination of multiple project components. Project sponsors will follow the steps outlined in Figure 1 to estimate the GHG emission reductions and selected co-benefits from the components making up the proposed project. Detailed instructions for each step are provided on subsequent pages. Section C shows an example of how to estimate GHG emission reductions and selected co-benefits from a retrofit and solar PV installation project.

Figure 1. Steps to Estimating GHG Emission Reductions and Selected Co-benefits



Step 1: Enter Basic Project Information

Project sponsors must complete this step using the Energy Corps Benefits Calculator Tool, available at: www.arb.ca.gov/cci-resources.

Users should begin with the **Read Me** tab, which contains general information about the Benefits Calculator Tool. The **Definitions** tab defines key terms. The **Documentation** tab provides details on the supporting documentation required for the calculations to be reviewed and replicated.

Input and output fields are color-coded:

- Green fields indicate direct user input is required.
- Gray fields indicate output or calculation fields that are automatically populated based on user entries and the calculation methods.
- Yellow fields indicate important tips.

In Step 1, input basic project information related to the project type, location, and costs in the **Project Info** tab. Table 1 identifies the required information to complete the **Project Info** tab.

Table 1. Required Basic Project Information for All Projects

Project Info tab
• Project name; • City in which project is located; • Building Climate Zone in which project is located;[2] • Contact name; • Contact phone number; • Contact email; • Date calculator completed (MM/DD/YYYY); • Total Energy Corps GGRF funds requested from this solicitation to implement the project ($); and • Total additional GGRF funds to implement the project, including GGRF funds previously awarded to the project by the Energy Corps or another California Climate Investments program, GGRF funds currently being requested from another California Climate Investments program, and GGRF funds to be requested in the future ($).

[2] See Appendix A for guidance on identifying the Building Climate Zone in which a project is located.

Step 2: Define Project Components and Determine Applicable Inputs and Methods

In Step 2, identify the components that make up the proposed project. Determine the necessary inputs to the appropriate tabs of the Energy Corps Benefits Calculator Tool and, if applicable, the PVWatts Calculator.

Project Components

The CCC developed two types of projects that meet the objectives of the Energy Corps and facilitate the reduction of GHG emissions. Other project features may be eligible for funding under the Energy Corps; however, the Energy Corps Quantification Methodology provides methods to estimate GHG emission reductions from projects which install at least one of the following:

- Energy efficient lighting fixtures or controls; or
- Grid-connected solar PV system.

Table 2 identifies the applicable tab of the Energy Corps Benefits Calculator Tool and, if necessary, third-party tool to estimate GHG emission reductions and co-benefits from each project component.

Table 2. Project Components and Applicable Quantification Methods

Project Component	Applicable Benefits Calculator Tab	Applicable Third-party Tool
Energy efficiency lighting retrofit	Retrofit Inputs	
Grid-connected solar PV system	Solar PV Inputs	PVWatts Calculator

Step 3: Estimate Benefits from Energy Efficiency Retrofits

Table 3 identifies the information required to complete the **Retrofit Inputs** tab.

Table 3. Required Inputs for Energy Efficiency Retrofits

Retrofit Inputs tab
• Building type (choose from office, school, or university); • Pre-existing and new fixture types (choose from CFL, fluorescent, halogen, high-pressure sodium, incandescent, LED, or metal halide); • Pre-existing and new fixture specifications (choose from type-specific drop-down); • Pre-existing and new fixtures quantities; and • Pre-existing and new control types (choose from daylight sensor, occupancy sensor, occupancy and daylight sensor, manual bi-level switch, or none).

Step 4: Estimate Benefits from Solar PV Systems

To evaluate annual electricity generation from grid-connected solar PV systems (**Step 4a**), use the PVWatts Calculator, available at: pvwatts.nrel.gov. To estimate total electricity generation over the project life, GHG emission reductions, and co-benefits (**Step 4b**), enter results from the PVWatts Calculator in the **Solar PV Inputs** tab.

Step 4a: Estimate Annual Solar PV Electricity Generation

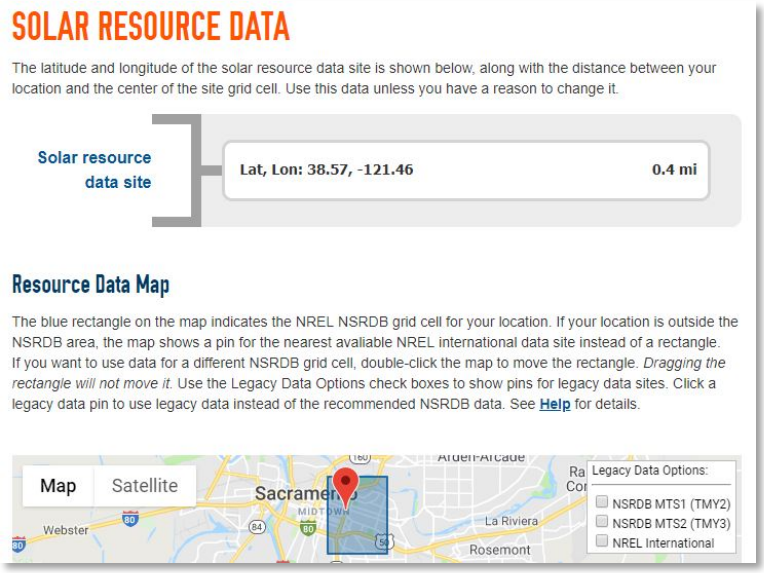
Project sponsors must complete this step using the PVWatts Calculator. Table 4 identifies the necessary inputs to estimate annual renewable electricity generation using the PVWatts Calculator.

Table 4. Required Inputs for Solar PV Systems

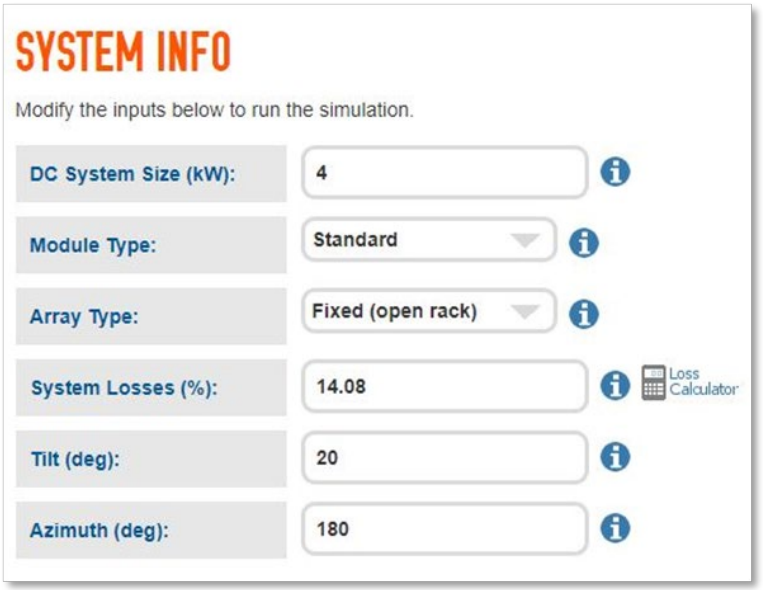
PVWatts Calculator
• Zip code; • DC system size (kW); • Module type (select from standard, premium, or thin film); and • Array type (select from fixed open rack, fixed roof mount, 1-axis tracking, 1-axis backtracking, or 2-axis tracking).

First, enter the zip code of the proposed solar PV system in the PVWatts Calculator.

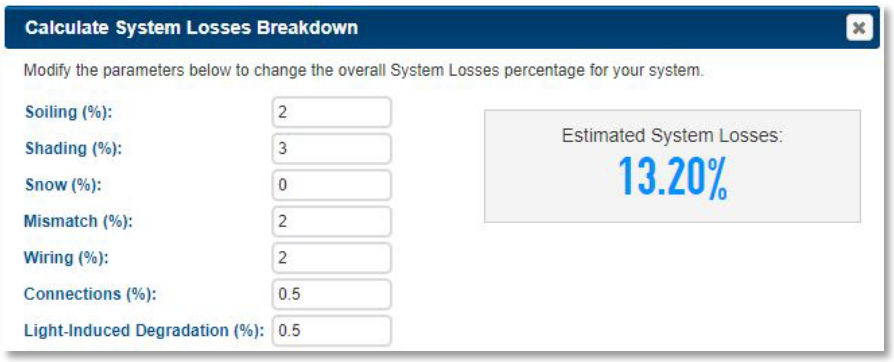
The *Solar Resource Data* page displays the coordinates of the grid cell used to identify data from the National Solar Radiation Database Physical Solar Model representing the long-term solar resource at the location. Applicants should not modify the pin location on the "Resource Data Map" or check any of the "Legacy Data Options."



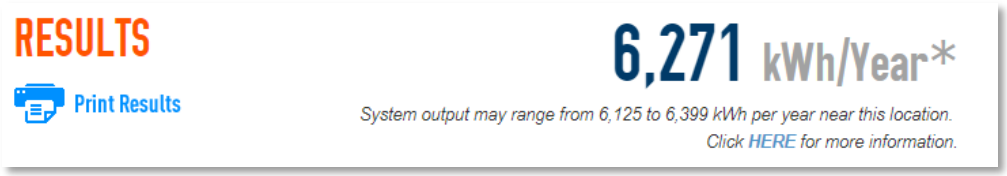
On the *System Info* page, input the solar PV system specifications identified in Table 8. Applicants should use the PVWatts default values for "Tilt" (20°) and "Azimuth" (180°) and should not modify "Advanced Parameters."



The PVWatts Calculator uses a default value of 1.5% for light-induced degradation, while the Energy Corps Benefits Calculator Tool uses 0.5%.[3] For consistency, applicants must change "Light-induced Degradation" from 1.5% to 0.5%.
To modify "Light-induced Degradation," select "Loss Calculator." On the *Calculate System Losses Breakdown* pop-up, change "Light-induced Degradation" to 0.5% and click "Save." Once all required inputs are entered, select "Go to PVWatts results."



The *Results* page displays the estimated monthly and annual electricity production of the proposed solar PV system. Download and submit the monthly results spreadsheet as supporting documentation for the completed Energy Corps Benefits Calculator Tool.



Step 4b: Estimate Lifetime Solar PV Electricity Generation and Benefits

Project sponsors must complete this step using the Energy Corps Benefits Calculator Tool. On the **Solar PV Inputs** tab, enter the annual solar PV electricity production estimate (kWh/year) from the top of the PVWatts Calculator results spreadsheet. The tool estimates the total electricity generation, GHG emission reductions, and co-benefits over the life of the solar PV system, 30 years.[4]

[3] The estimated rate of system degradation was obtained from the National Renewable Energy Laboratory Technical Report "Photovoltaic Degradation Rates – An Analytical Review." 2012. www.nrel.gov/docs/fy12osti/51664.pdf

[4] The 30-year useful life was obtained from the National Renewable Energy Laboratory "Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics" fact sheet. www.nrel.gov/docs/fy13osti/56487.pdf

Step 5: Review Estimated Benefits of Project

Once all inputs are complete, review the **GHG Summary** and **Co-benefits Summary** tabs for the GHG emission reductions and selected co-benefits of the proposed project. If there are any errors or blank cells, ensure that all information from **Steps 1 through 4** has been entered correctly.

Project benefits are prorated according to the share of funding contributed from the Energy Corps and other California Climate Investments programs funded with GGRF, as applicable. Each result is estimated per total GGRF funds and Energy Corps GGRF funds, where the results per Energy Corps GGRF funds represent the portion of the project benefits attributable to funding from the Energy Corps.

The **GHG Summary** tab displays the estimated:

- Total GHG emission reductions ($MTCO_2e$);
- GHG emission reductions attributable to Energy Corps GGRF funds ($MTCO_2e$);
- Total GHG emission reductions per total GGRF funds ($MTCO_2e$/$); and
- Total GHG emission reductions per Energy Corps GGRF funds ($MTCO_2e$/$).

The **Co-benefits Summary** tab displays estimated key variables and co-benefits per total GGRF funds and Energy Corps GGRF funds:

- NO_x emission reductions (lbs);
- ROG emission reductions (lbs);
- $PM_{2.5}$ emission reductions (lbs);
- Energy and fuel cost savings ($);
- Renewable energy generation (kWh); and
- Fossil fuel energy use reductions (kWh).

Step 6: Submit Supporting Documentation

Finally, use the checklists on the **Documentation** tab to ensure that all supporting documentation necessary for the relevant project components is provided. The **Documentation** tab outlines general documentation requirements for all projects as well as requirements specific to each project component.

Section C. Example Project

Introduction

The following is a hypothetical project[5] to demonstrate how the Energy Corps Benefits Calculator Tool would be applied. This hypothetical project does not provide examples of the supporting documentation required of actual project sponsors.

Overview of the Proposed Project

The proposed project is an energy efficiency retrofit and solar PV system installation at a school in Sacramento. The project requested $15,000 from Energy Corps. No other funding has been or will be sought. Table 5 describes each project component.

Table 5. Example Project Characteristics by Component

Example Project
Energy Efficiency Retrofit • 50 24" fluorescent T12 2-lamps to be replaced with 50 24" fluorescent T8 2-lamps; • 5 48" fluorescent T12 3-lamps to be replaced with 5 48" fluorescent T8 3-lamps; • All lamps to be controlled by occupancy sensors; and • No pre-existing lighting controls. **Solar PV System** • 100 kW grid-connected solar PV system with standard modules and fixed roof-mounted array, located in zip code 95816 for school use.

Step 1: Enter Basic Project Information

First, enter basic project information on the **Project Info** tab. Use the map in Appendix A to identify the Building Climate Zone where the project is located: 12.

Project Name	Example
City	Sacramento
Building Climate Zone	12
Contact Name	Example
Contact Phone Number	123-456-7890
Contact Email	example@example.com
Date Calculator Completed	9/30/2019
Energy Corps GGRF Funds Requested ($)	$15,000
Other GGRF Leveraged Funds ($)	$0
Total GGRF Funds ($)	$15,000

[5] The hypothetical project has not undergone verification of any Energy Corps requirements; all assumptions about location and project features are for Energy Corps Benefits Calculator Tool demonstration purposes only.

Step 2: Define Project Components and Determine Applicable Inputs and Methods

The proposed project includes two quantifiable components: replacement of lighting fixtures and controls and installation of a solar PV system. Refer to Table 2 to identify the applicable tab of the Energy Corps Benefits Calculator and third-party tool for quantification of each component. Then refer to Tables 3 and 4 to determine the project-specific inputs needed to estimate the benefits of each component.

Step 3: Estimate Benefits from Energy Efficiency Retrofits

On the **Retrofit Inputs** tab, select the type of building in which the project will occur and describe the lighting fixtures to be removed and installed.

Pre-existing Measures				
Building Type	Fixture Type	Fixture Specifications	Quantity	Control Type
School	Fluorescent T12	24" 2-lamp	50	None
School	Fluorescent T12	48" 3-lamp	5	None

New Measures			
Fixture Type	Fixture Specifications	Quantity	Control Type
Fluorescent T8	24" 2-lamp	50	Occupancy Sensor
Fluorescent T8	48" 3-lamp	5	Occupancy Sensor

Step 4: Estimate Benefits from Solar PV System

Use the PVWatts Calculator and the Energy Corps Benefits Calculator Tool to estimate the benefits of the proposed solar PV system.

Step 4a: Estimate Annual Solar PV Electricity Generation

Describe the proposed solar PV system in the PVWatts Calculator and adjust "Light-induced Degradation" to 0.5% using the "Loss Calculator."

Proceed to the *Results* page.

Step 4b: Estimate Lifetime Solar PV Electricity Generation and Benefits

Enter the estimated annual solar PV electricity production from PVWatts in the **Solar PV Inputs** tab.

Solar Photovoltaic Electricity Generation	
Annual Electricity Generation (kWh/year)	156,772
Total Electricity Generation (kWh)	4,377,570

Step 5: Review Estimated Benefits of Project

Review the **GHG Summary** and **Co-benefits Summary** tabs for the GHG emission reductions and selected co-benefits of the proposed project. If there are errors or blank cells, ensure that all information from **Steps 1 to 4** has been entered correctly.

GHG Summary	
Total GHG Emission Reductions ($MTCO_2e$)	1,014
Energy Corps GHG Emission Reductions ($MTCO_2e$)	1,014
Total GHG Emission Reductions per Total GGRF Funds ($MTCO_2e$/$)	0.067595
Total GHG Emission Reductions per Energy Corps GGRF Funds ($MTCO_2e$/$)	0.067595

Co-benefits and Key Variables	Per Total GGRF Funds	Per Energy Corps GGRF Funds
NO_x Emission Reductions (lbs)	569	569
ROG Emission Reductions (lbs)	91	91
$PM_{2.5}$ Emission Reductions (lbs)	143	143
Energy and Fuel Cost Savings ($)	$731,959	$731,959
Renewable Energy Generation (kWh)	4,377,570	4,377,570
Fossil Fuel Energy Use Reductions (kWh)	72,026	72,026

Step 6: Submit Supporting Documentation

Finally, use the checklists on the **Documentation** tab to identify supporting documentation necessary for the relevant project components.

	Documentation for All Projects	Completed?
1	Contact information for the person who can answer project specific questions from staff reviewers on the quantification calculations	Yes
2	Project description, including excerpts or specific references to the location in the main Energy Corps application of the project information necessary to complete the applicable portions of this Benefits Calculator Tool.	Yes
3	Populated Energy Corps Benefits Calculator Tool (this file) (in .xls) with worksheets applicable to the project populated (ensure that all fields in the GHG Summary and Co-benefits Summary tabs are populated)	Yes
4	Any other information as necessary and appropriate to substantiate Energy Corps Benefits Calculator Tool inputs	Yes

	Documentation for Energy Efficiency Retrofits	Completed?
1	Documentation of the number and type of lighting fixtures and controls to be replaced and installed and of the project building type, if applicable	Yes

	Documentation for Solar PV Systems	Completed?
1	Electronic copy of PVWatts results spreadsheet for proposed solar PV system, if applicable	Yes
2	Documentation of the proposed number of solar PV panels and Watts per panel, if applicable	Yes

Appendix A. Building Climate Zone

To determine the Building Climate Zone in which a project is located, project sponsors should consult the California Energy Commission's Building Climate Zones map, available at: www.energy.ca.gov/maps/renewable/building_climate_zones.html